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ORIGINAL PAPER

Safety and efficacy of pterygium extended removal followed by extended conjunctival transplant for recurrent pterygia

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Abstract

Purpose To study the safety and efficacy of pterygium extended removal followed by extended conjunctival transplant for recurrent pterygia.

Methods Thirty-three eyes of 33 subjects with recurrent pterygia were enrolled in this prospective case series study. Pterygium extended removal followed by extended conjunctival transplantation was performed in all subjects. One surgeon (WA) performed all surgeries. All subjects completed follow-up for at least 12 months and were evaluated for recurrence and complications.

Results The mean age of the participants was 41.2 ± 10.3 years (range 22–60), 7 females (21.2%). The mean duration of follow-up was 25.64 ± 9.24 months (range 12–43). Corrected distance visual acuity (decimal notation) improved from 0.69 ± 0.22 (range 0.2–1.0) at presentation to a 1-year postoperative value of 0.83 ± 0.2 (range 0.3–1.0). No recurrence was reported in all subjects throughout the follow-up period. Transient graft swelling was recorded in 14 cases (42.4%) and resolved in all cases by the first week. All patients developed variable degrees of transient postoperative diplopia that resolved completely by the first 6 weeks. Donor site granuloma developed in 4 cases (12.1%). Spontaneous resolution was observed in 3 cases, while in one case, surgical excision was performed 2 months after the procedure.

Conclusions In this study of eyes with recurrent pterygia, pterygium extended removal followed by extended conjunctival transplant was found safe and effective with no recurrence and minimal postoperative complications.

Keywords Recurrent pterygium · PERFECT for PTERYGIUM®

Introduction

Pterygium is a common conjunctival degenerative disorder in which a wedge-shaped uncontrolled fibrovascular lesion encroaches over the cornea [1]. In addition to cosmetic concerns by patients, it can lead to significant ocular morbidity, especially if large in size, including chronic ocular irritation, limitation of ocular motility, and visual impairment due to visual axis obscuration and irregular astigmatism [2, 3].

The traditional treatment for pterygium, excision with bare sclera, is significantly complicated with recurrence. In most cases, it is necessary to remove recurrent pterygia due to aggressive fibrovascular

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growth and adhesion to the surrounding structures [4]. Moreover, recurrent pterygia are further complicated by greater probability of additional recurrence and shorter time period between recurrences [5].

Multiple adjunctive treatment modalities have been used specifically to address the issue of recurrence after pterygium removal, such as amniotic membrane transplantation, anti-vascular endothelial growth factor (anti-VEGF) and anti-fibrotic agents [6–10] However, conjunctival autograft is the most popular treatment modality as it evades the significant complications of anti-fibrotic agents and provides better cosmetic outcomes than amniotic membrane transplantation [8, 11, 12]. Moreover, pterygium extended removal followed by extended conjunctival transplant (PERFECT for PTERYGIUM®) has been reported to significantly reduce the recurrence rate of pterygium with few postoperative complications and excellent cosmetic outcomes in both primary and recurrent pterygia [13–15].

Our study aimed at assessment of safety, efficacy, recurrence rate and complications of pterygium extended removal followed by extended conjunctival transplant (PERFECT for PTERYGIUM®) in cases with recurrent pterygia.

Materials and methods

This prospective, interventional, case series study was conducted at Ibn Sina Eye Center in Tanta, Egypt between April 2016 and December 2018. Thirty-three eyes of 33 patients with recurrent pterygia were enrolled in the study. Recurrence of the pterygium was defined as new fibrovascular growth passing the limbus that was not present in the first postoperative day. Patients with primary pterygia, concomitant ocular surface diseases, glaucoma, and glaucoma suspects were excluded from the study.

The study was performed in conformity with the Health Insurance Portability and Accountability Act and the principles of the Declaration of Helsinki. Study approval was obtained from Tanta University Institutional Review Board (IRB)/Ethics Committee. The nature of the disease, treatment options, as well as the nature of the procedure and its potential complications were all discussed with the participants before signing written informed consents which also included the agreement to publish their eye images. No fund was received for that project.

A comprehensive ophthalmic examination was conducted on every patient, including uncorrected distance visual acuity (UDVA), manifest refraction, corrected distance visual acuity (CDVA), slit-lamp biomicroscopy, intraocular pressure measurement, and dilated ophthalmoscopy. Colored photographs were obtained to document the lesions before and after the procedure.

All surgeries were performed by one surgeon (WA). All patients underwent pterygium extended removal followed by extended conjunctival transplant (PERFECT for PTERYGIUM®) according to the technique described by Hirst in 2008 [13] with little modifications applied by the operating surgeon and discussed previously in an earlier publication [15].

Surgical technique

Topical anesthesia was administered in the form of 0.4% benoxinate hydrochloride (EIPICO. Cairo, Egypt) together with peribulbar anesthesia. Systemic sedation was administered to anxious patients. The eye to be operated was prepped and draped in a sterile manner. A lid speculum was inserted and an 8/0 Vicryl traction suture was placed close to the limbus at the upper nasal quadrant of the cornea to help handle the globe in different directions, providing maximum exposure of the surgical field during all surgical steps. A surgical marking pen was utilized to mark the exact area occupied by the lesion.

After injecting 2.0% lidocaine beneath the pterygium body, Westcott scissors were utilized to fashion two radial cuts, including the conjunctiva and Tenon's capsule, starting at the limbus just above and below the pterygium neck. The cuts then extend nasally, all the way to the caruncle, along the upper and lower margins of the pterygium guided by the previous marking.

Fixation forceps was used to elevate the pterygium body that was undermined using scissors. After that, the 2 radial incisions were connected by means of a circumferential incision at the nasal end of the lesion, taking care not to traumatize the medial rectus muscle.

The pterygium body was then temporally reflected over the cornea after meticulous dissection of all adhesions between the lesion and the underlying medial rectus muscle and sclera. The next step was to

gently peel the head off the cornea by means of blunt separation, starting from the limbus, after identification of the proper plane.

After adequate hemostasis, an extended tenonectomy was performed. The conjunctiva was elevated along the upper and lower radial cuts using non-toothed forceps, so Westcott scissors could be introduced to carefully dissect the conjunctiva from the underlying Tenon's capsule for about 10 mm close to the limbus and 15 mm posteriorly, extending close to the superior and inferior recti muscles. Similarly, the Tenon's capsule was dissected from the sclera to the same extent. Tenon's capsule was then incised at the limbus, taking care not to injure the overlying conjunctiva, to create 2–3 mm circumlimbal superior and inferior incisions. Toothed forceps were then used to gently grasp the Tenon's capsule, and a hand-over-hand technique was performed to conduct an extensive Tenon's excision extending to the vicinity of the superior and inferior recti muscles and as far as the caruncle at the nasal side.

The upper and lower conjunctival incisions were then trimmed to fashion straight edges and the semilunar fold was removed, leaving only about 2 mm of the paracaruncular conjunctiva. Hemostasis was performed as necessary through cautious applications of a wet-field cautery.

In order to harvest a wide conjunctival autograft, the upper area of bulbar conjunctiva was widely exposed by turning the eye downwards with the help of the limbal traction 8/0 Vicryl suture. A surgical marking pen was utilized to mark the border of the intended graft depending on the size of the conjunctival defect at the recipient bed. Two marks were placed starting at the limbus 6–8 mm apart, and extending posteriorly in a radial fashion all the way to the upper fornix where they were separated by about 15 mm. The 2 upper ends of the radial lines were then joined by a horizontal mark. A 3–5 mm wide island of intact conjunctiva was left between the recipient bed and the area of the intended graft dissection.

Subconjunctival lidocaine 2.0% was then injected under the marked area to facilitate separation of the conjunctiva from the Tenon's capsule. Conjunctival incisions were then carefully made along the marked lines, taking care not to involve the Tenon's capsule. After that, the conjunctiva was undermined and separated from the Tenon's capsule, by means of Wescott scissors, all the way down to the upper limbus to include corneal limbal stem cells in the graft. The recipient bed was adequately exposed by turning the eye temporally with the help of the bridle suture and the graft was carefully transferred to the bed, keeping its limbus-to-limbus orientation. The upper and lower limbal corners of the graft were then sutured to the conjunctiva at the limbus by 8/0 Vicryl sutures, while the posterior corners were fixed to the conjunctiva by sutures that included episcleral tissue for secure fixation. The posterior sutures were located about 13–14 mm behind the limbus and 3 mm above and below the medial rectus muscle.

The upper and lower borders of the graft were then sutured to the conjunctiva by interrupted sutures, and the posterior edge was sutured to the caruncle using continuous suture.

Postoperative follow-up

Postoperatively, oral analgesics were given for the first 3 days, and topical combination of tobramycin 0.3% and dexamethasone 0.1% (TobraDex ophthalmic suspension; Alcon Laboratories Inc, Fort Worth. TX, USA) was administered 5 times per day for the first week. Eye patch was applied till complete epithelialization of the cornea.

All patients were checked on the first postoperative day then after 1 week, 1, 3, 6, and 12 months. Additional visits were also scheduled if needed together with regular yearly follow-up visits.

During all visits, visual acuity evaluation, slit-lamp examination, intraocular pressure measurement were all performed. Manifest refraction was tested from the first postoperative month on. The patients were meticulously examined for signs of infection, graft swelling and/or dislodgement, suture related problems, postoperative diplopia, granuloma formation, and evidence of pterygium recurrence; defined as new fibrovascular creeping over the limbus.

Statistics

Statistical analysis was performed using the SPSS software version 20 (IBM, Armonk, NY) and values were reported as mean ± standard deviation. The paired t-test was performed to compare the means before and after 12 months of surgery. A p value ≤ 0.05 was considered to be statistically significant.

Results

Thirty-three eyes from 33 patients were enrolled in this prospective study between April 2016 and December 2019. The mean age of the participants was 41.2 ± 10.3 years (range 22–60), 7 females (21.2%). Twenty-one subjects had single previous pterygium surgery, 9 subjects had 2 previous surgeries, and 3 subjects had 3 previous surgeries. All previous surgeries were pterygium excision with conjunctival autograft. The mean size of the pterygium was 2.61 ± 0.66 mm (range 1.50–3.50). The pterygium was nasal in all subjects. The mean time of pterygium recurrence after the primary surgery was 7 ± 0.81 months. Three subjects had limited ocular motility in the form of limited abduction with binocular diplopia. The mean postoperative follow-up duration was 25.64 ± 9.24 months (range 12–43). All cases were followed for at least 12 months. Intraoperatively, there were no significant complications except for small graft button-hole defects that took place during dissection in 5 cases. All defects healed during the early postoperative period with no sequelae.

After surgery, full re-epithelialization of the corneal epithelial defects was achieved within the first 5–7 days, and no graft dislodgment was reported. Corrected distance visual acuity (decimal notation) improved from 0.69 ± 0.22 (range 0.2–1.0) at presentation to a postoperative value of 0.83 ± 0.2 (range 0.3–1.0) at the 12 months ($p < 0.001$). All patients developed variable degrees of transient postoperative diplopia that resolved completely by the first 6 weeks. All cases with preoperative limitation of ocular motility demonstrated full range restoration by the first 12 weeks after the procedure.

Transient graft edema developed in 14 cases (42.2%) and resolved completely in all cases by the first week.

Donor site scarring was not observed. However, donor site granuloma developed in 4 cases (12.1%). Spontaneous resolution was observed in 3 cases, while one case required surgical excision 2 months after the procedure. No cases developed any suture related granuloma.

No recurrence was reported in our cohort over the follow-up period and no additional complications were observed such as infection, scleral melting or thinning (Fig. 1).

Discussion

Previous studies have shown a variable recurrence rate of pterygium after conjunctival autograft and other adjunctive modalities. In general, the recurrence rate ranged from 12.5 to 33% [5, 10, 16–18]. However, it was reported that pterygium extended removal followed by extended conjunctival transplant (PERFECT for PTERYGIUM®) resulted in a near zero recurrence rate and excellent cosmetic results in both primary and recurrent pterygia [13–15]. Therefore, in our study, we assessed the safety, efficacy, and recurrence rate of this technique in cases with recurrent pterygia.

In this study, no recurrence was reported after a minimum of 12 months of follow-up. Significantly reduced recurrence rate with extensive excision of the conjunctival fibrovascular tissue and Tenon's layer may be explained by the in vitro studies that evaluated growth factors and angiogenic factors released from pterygial fibroblasts. It was reported that these factors play a pivotal role in sustaining the neovascularization and progression of pterygium [19, 20]. However, this technique requires surgical expertise, prolonged surgery time, and may be associated with a greater incidence of complications related to the large size conjunctival autograft such as button-hole defects of the graft, transient postoperative graft swelling, and conjunctival granuloma at the donor site. Zhang et al. [21] reported the development of conjunctival granuloma in 1.3 and 2.2% of cases with primary and recurrent pterygia, respectively. Despite the higher incidence (12%) in our cohort, donor site granuloma did not affect the final outcome of the procedure with spontaneous resolution in 3 cases during the early postoperative course, and only one case required surgical excision without any sequelae. Conjunctival granuloma may develop as a result of several causes such as foreign bodies (suture or filament), irregular or laxly sutured conjunctival wound, inflammation, and infection [21, 22].

However, none of our patients had conjunctival sutures or infection at the door site, so the granuloma might had developed as a result of postoperative inflammation.

Similarly, button-hole defects healed postoperatively without complications, and transient graft swelling faded spontaneously after one week.

There is a great benefit of this technique as the recurrence rate of pterygium is high in the Egyptian

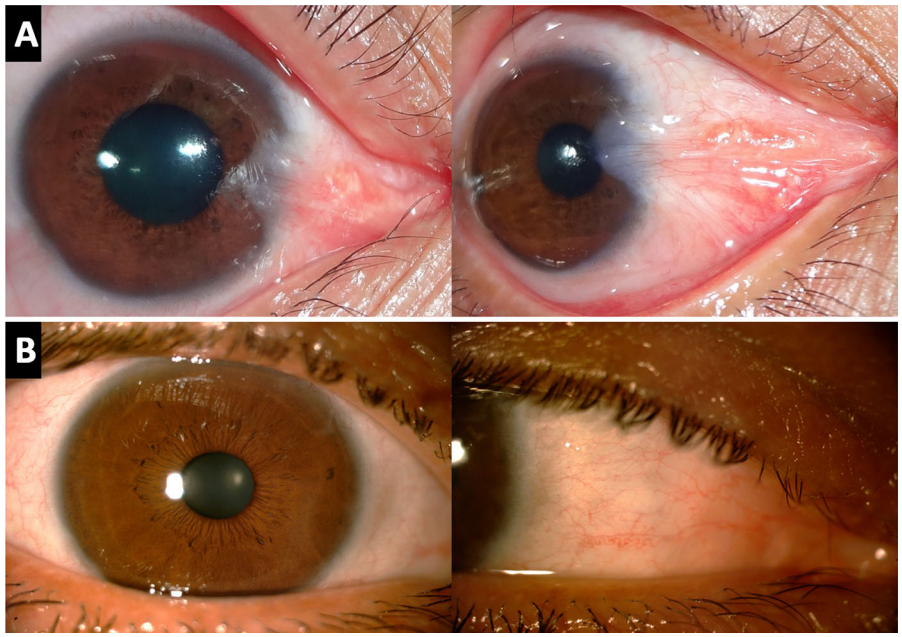

Fig. 1 External photographs of recurrent pterygium before (**A**) and 21 months after pterygium extended removal followed by extended conjunctival transplant (PERFECT for PTERYGIUM®) with the absence of a visible suture line

population due to greater solar exposure. We reviewed the patients records in our hospital and calculated the recurrence rate over 1 year to be 36% after pterygium excision with simple autograft.

In this study, no patients developed scarring at the donor site. Meticulous and minimally traumatizing surgical technique by fashioning a thin conjunctival graft without including any of the underlying Tenon's layer plays an important role in reducing the incidence of scarring [23].

Few modifications were added, in our study, to the original technique described by Hirst [13]. First, we abandoned the use of medial rectus fixation suture that was used in the original technique. Instead, an 8/0 Vicryl traction suture was placed at the upper nasal limbus and was used to rotate the globe in the desired direction providing excellent exposure of the surgical field with minimal surgical trauma to the muscle. Second, Hirst described leaving an intact 1.5–2 mm rim of the limbal conjunctiva during dissection of the conjunctival graft and leaving a similar region of bare sclera at the limbus during fixation of the graft which will be re-epithelialized by the corneal epithelium. Given the benefits of limbal stem cell transplantation to the recipient bed especially in the treatment of recurrent pterygia [24, 25], we dissected the graft all the way down to the upper limbus in order to include limbal stem cells.

Hirst [13, 14] reported transient postoperative diplopia in almost all patients with either primary or recurrent pterygia, possibly from surgical trauma with subsequent underaction of medial rectus muscle. Another study reported a lower incidence (17.6%) in cases of primary pterygia due to the avoidance of medial rectus fixation suture [15]. However, in this study, variable degrees of binocular diplopia were reported in almost all patients with mild limitation of ocular motility. This high incidence might be due to the greater amount of surgical manipulations required in recurrent pterygium cases in order to release the adhesions to the medial rectus muscle and surrounding tissues. Diplopia resolved spontaneously in all patients within 6 weeks from surgery. Other two recommendations from the original technique to decrease diplopia include a little forward suturing of the graft to the sclera and keeping the para-canalicular suture line lax over the medial rectus muscle.

Our study had some limitations. First, no control group was included in the study; thus, we were not able to compare our technique to other surgical modalities or adjunctive therapies. However, the zero% recurrence rate reported herein may prove the

superiority of this technique over all other available treatment modalities. Second, the sample size was relatively small. However, we watched for recurrence over a long follow-up interval. Third, the superior conjunctival graft might challenge future glaucoma filtration surgeries. Although we did not include glaucoma patients and suspects in the study, possible development of glaucoma in the future remains a major concern. However, we did not find any postoperative donor site scarring in any of our cases.

In summary, we found that pterygium extended removal followed by extended conjunctival transplant (PERFECT for PTERYGIUM®) appears to be a safe and effective treatment modality for recurrent pterygia with a zero% recurrence and minimal complications.

Author contribution Conception and design: Allam and Alagorie. Analysis and interpretation: Alagorie and El-Bakary. Data collection: Nasef. Overall responsibility: Allam and Nasef.

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Declarations

Conflict of interest The authors declares that they have no conflict of interest.

Consent for publication Consent was obtained and approved by ethics committee.

Ethical approval All procedures performed were in accordance with the ethical standards of the Tanta University research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Human or Animal Rights No animals included in the study.

Consent to participation Consent was obtained and approved by Tanta University Institutional Review Board ethics committee.

References

1. Kaufman SC, Jacobs DS, Lee WB et al (2013) Options and adjuvants in surgery for pterygium: a report by the American Academy of Ophthalmology. Ophthalmology 120:201–208. https://doi.org/10.1016/j.ophtha.2012.06.066
2. Han SB, Jeon HS, Kim M et al (2016) Quantification of astigmatism induced by pterygium using automated image analysis. Cornea 35:370–376. https://doi.org/10.1097/ICO.0000000000000728
3. Twelker JD, Bailey IL, Mannis MJ, Satariano WA (2000) Evaluating pterygium severity: a survey of corneal specialists. Cornea 19:292–296. https://doi.org/10.1097/00003226-200005000-00007
4. Hirst LW, Sebban A, Chant D (1994) Pterygium recurrence time. Ophthalmology 101:755–758. https://doi.org/10.1016/s0161-6420(94)31270-x
5. Shimazaki J, Kosaka K, Shimmura S, Tsubota K (2003) Amniotic membrane transplantation with conjunctival autograft for recurrent pterygium. Ophthalmology 110:119–124. https://doi.org/10.1016/s0161-6420(02)01453-7
6. Ozgurhan EB, Agca A, Kara N et al (2013) Topical application of bevacizumab as an adjunct to recurrent pterygium surgery. Cornea 32:835–838. https://doi.org/10.1097/ICO.0b013e3182772d4e
7. Lekhanont K, Patarakittam T, Thongphiew P et al (2012) Randomized controlled trial of subconjunctival bevacizumab injection in impending recurrent pterygium: a pilot study. Cornea 31:155–161. https://doi.org/10.1097/ICO.0b013e3182151e0e
8. Kucukerdonmez C, Akova YA, Altinors DD (2007) Comparison of conjunctival autograft with amniotic membrane transplantation for pterygium surgery: surgical and cosmetic outcome. Cornea 26:407–413. https://doi.org/10.1097/ICO.0b013e318033b3d4
9. Hurmeric V, Vaddavalli P, Galor A et al (2013) Single and multiple injections of subconjunctival ranibizumab for early, recurrent pterygium. Clin Ophthalmol 7:467–473. https://doi.org/10.2147/OPTH.S40400
10. Ma DH-K, See L-C, Hwang Y-S, Wang S-F (2005) Comparison of amniotic membrane graft alone or combined with intraoperative mitomycin C to prevent recurrence after excision of recurrent pterygia. Cornea 24:141–150. https://doi.org/10.1097/01.ico.0000141237.71837.d8
11. Luanratanakorn P, Ratanapakorn T, Suwan-Apichon O, Chuck RS (2006) Randomised controlled study of conjunctival autograft versus amniotic membrane graft in pterygium excision. Br J Ophthalmol 90:1476–1480. https://doi.org/10.1136/bjo.2006.095018
12. Prabhasawat P, Barton K, Burkett G, Tseng SC (1997) Comparison of conjunctival autografts, amniotic membrane grafts, and primary closure for pterygium excision. Ophthalmology 104:974–985. https://doi.org/10.1016/s0161-6420(97)30197-3
13. Hirst LW (2008) Prospective study of primary pterygium surgery using pterygium extended removal followed by extended conjunctival transplantation. Ophthalmology 115:1663–1672. https://doi.org/10.1016/j.ophtha.2008.03.012
14. Hirst LW (2009) Recurrent pterygium surgery using pterygium extended removal followed by extended conjunctival transplant: recurrence rate and cosmesis. Ophthalmology 116:1278–1286. https://doi.org/10.1016/j.ophtha.2009.01.044
15. Allam WA (2016) Recurrence and complications of pterygium extended removal followed by extended conjunctival transplant for primary pterygia. Eur J Ophthalmol 26:203–208. https://doi.org/10.5301/ejo.5000685
16. Ti SE, Chee SP, Dear KB, Tan DT (2000) Analysis of variation in success rates in conjunctival autografting for primary and recurrent pterygium. Br J Ophthalmol 84:385–389. https://doi.org/10.1136/bjo.84.4.385

17. Fallah MR, Golabdar MR, Amozadeh J et al (2008) Transplantation of conjunctival limbal autograft and amniotic membrane vs mitomycin C and amniotic membrane in treatment of recurrent pterygium. Eye (Lond) 22:420–424. https://doi.org/10.1038/sj.eye.6702657
18. Fernandes M, Sangwan VS, Bansal AK et al (2005) Outcome of pterygium surgery: analysis over 14 years. Eye (Lond) 19:1182–1190. https://doi.org/10.1038/sj.eye.6701728
19. Kria L, Ohira A, Amemiya T (1998) TNP-470 (a fungus-derived inhibitor of angiogenesis) reduces proliferation of cultured fibroblasts isolated from primary pterygia: a possible drug therapy for pterygia. Curr Eye Res 17:986–993. https://doi.org/10.1076/ceyr.17.10.986.5245
20. Kria L, Ohira A, Amemiya T (1998) Growth factors in cultured pterygium fibroblasts: immunohistochemical and ELISA analysis. Graefes Arch Clin Exp Ophthalmol 236:702–708. https://doi.org/10.1007/s004170050144
21. Zhang Z, Yang Z, Pan Q et al (2018) Clinicopathologic characteristics and the surgical outcome of conjunctival granulomas after pterygium surgery. Cornea 37:1008–1012. https://doi.org/10.1097/ICO.0000000000001647
22. Kapadia SB, Heffner DK (1992) Pitfalls in the histopathologic diagnosis of pyogenic granuloma. Eur Arch Otorhinolaryngol 249:195–200. https://doi.org/10.1007/BF00178468
23. Syam PP, Eleftheriadis H, Liu CSC (2003) Inferior conjunctival autograft for primary pterygia. Ophthalmology 110:806–810. https://doi.org/10.1016/S0161-6420(02)01970-X
24. Jha KN (2008) Conjunctival-limbal autograft for primary and recurrent pterygium. Med J Armed Forces India 64:337–339. https://doi.org/10.1016/S0377-1237(08)80015-9
25. Gris O, Guell JL, del Campo Z (2000) Limbal-conjunctival autograft transplantation for the treatment of recurrent pterygium. Ophthalmology 107:270–273. https://doi.org/10.1016/s0161-6420(99)00041-x